of western North America. Such plants are often mistakenly assumed to be part of a high mountain arctic-alpine flora. Thellung (1906) made such a mistake when he referred to *L. nanum* as an alpine plant.

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REVIEW

The Genus Crepis. Part I. The Taxonomy, Phylogeny, Distribution, and Evolution of Crepis. Part II. Systematic Treatment. By Ernest Brown Babcock. University of California Publications in Botany, vol. 21, pp. xii + 1–198, frontispiece, plate 1, figs. 1–11, tables 1–12; vol. 22, pp. x + 199–1031, plates 2–36, figs. 12–305, tables 13–19. 1947.

Hieracium excepted, *Crepis* is the largest genus of the tribe Cichorieae, family Compositae. Its one hundred and ninety-six species are distributed widely over much of Eurasia, Africa, and western North America, with their greatest concentration in the Mediterranean region. The cytology, genetics, cytogenetics, evolution, and systematics of these species have been subjected to lifelong study by Professor Babcock with the assistance of many co-workers. The results of these studies are effectively summarized in the present outstanding contribution. Space does not allow, in a short review, even mention of more than a few of the important and fundamental discoveries. Those who desire to know more will have to consult the original source which will surely become one of the classics of systematic botany.

Professor Babcock is one of the pioneers of the modern idea that systematics should correlate and integrate all evidence pertinent to the interrelationships of organisms, regardless of its source, and the present study fully substantiates that thesis. The primary sources of evidence are the classic criteria of comparative morphology and geographical distribution, yet these in themselves may not be always reliable, and the instances in which evidence from comparative cytology, genetics, cytogenetics, or geology has proved critical are legion. Once all of the facts are assembled, the evidence from each of these sources strengthens that from each other, and as a whole points to a definitive and unequivocal conclusion. On this broad basis of fact, gleaned from many diverse approaches, though still incomplete in places, Professor Babcock's conclusions rest, and it probably is no overstatement

that no systematic work of comparable magnitude has ever rested on a firmer foundation.

On the basis of comparative morphology, *Crepis* is divided into primitive, intermediate, and advanced groups of species. These groups, though often referred to, are not given taxonomic status, their relationship being horizontal rather than vertical. The most primitive species are those with perennial rhizomes, large lyrate leaves, and few large heads with very large florets and achenes, and an involucre consisting of many large bracts which remain unchanged at maturity. These are obviously adapted to a mesophytic climate, and are presumed to have persisted with little change since their origin, perhaps in the middle of the Tertiary period. The most advanced species include those of short-annual duration, with tap roots, smaller dissected leaves, and numerous small heads with small florets and achenes, and an involucre of few small bracts which become thickened at maturity. These have become specialized to xeric conditions, and are much more recent in origin. Between these two extremes are found most of the species of *Crepis,* specialized in one way or another along several different lines of development.

One hundred and thirteen species have been studied cytologically. These, excluding ten North American species of the section Psilochaenia, which are polyploid, $x = 11$, and six polyploid Old World species, are all diploid, $n = 7$, 6, 5, 4, or 3, with 4-paired species greatly predominating. Six is held to have been the primitive basic number of chromosomes, this number being possessed by some of the most primitive rhizomatous species, with 5, 4, and 3 being derived through a progressive series of reductions. This is correlated with a decrease in chromosome symmetry, and a decrease in chromosome size, and each step is thought to have occurred independently on several occasions. The group of species with $n = 7$, the section Ixeridopsis, is not the most primitive, and because of morphological and cytological resemblances is assumed to have arisen through intergeneric hybridization with *Ixeris.* Another group, the section Pyrimachos, which has not been studied cytologically, and a single aberrant species, *C. paludosa,* $n = 6$, may also have arisen by intergeneric hybridization. Aside from these three possible exceptions, the morphological and cytological evidence supports the generalization that *Crepis* is monophyletic.

The evidence from genetics and cytogenetics also is limited by the number of species which it has been possible to bring into cultivation. This evidence is extensive, however, many species having been crossed, and the resulting hybrids studied. In general, the more closely related the species, the more readily they may be crossed, the more vigorous and fertile the offspring, and the more nearly homologous the chromosomes as revealed by meiotic pairing. From this and the occurrence of similar genic

mutations in widely separated species, it is inferred that the genetic background is similar in all of the species investigated. This in turn supports the hypothesis of monophylesis. It follows that evolution in *Crepis* has taken place on the diploid level through the accumulation of genic mutations, and a rearrangement of these genic materials through chromosome changes. Polyploidy and intergeneric hybridization have been relatively unimportant as far as the genus as a whole is concerned.

On the basis of comparative morphology, geographical distribution, and chromosome numbers, it is inferred that the twenty-seven genera of the subtribe Crepidinae including *Crepis,* originated from the primitive genus *Dubyaea* or now extinct *Dubyaea*-like species. That the genus *Crepis* originated in central Asia near the middle of the Tertiary period is supported by geological, geographical, and biological evidence. It is from this area that the natural phyletic lines in the genus radiate. Relics of the putatively ancestral genus are preserved nearby, as are primitive members of related genera. These primitive members of *Crepis* and those of related genera are mesophytes which in itself suggests a temperate mid-Tertiary development. That this is a likely hypothesis is shown by a review of Tertiary history.

Matthew's principle is called on for additional support of the central Asiatic origin of *Crepis.* It is true that the distributions of some of the primitive species do conform to this dictum, but the dictum itself rests on the unsupported premise that evolutionary forces are most effective at the center of origin, hence each successive wave of outward migration would be more advanced than those that have gone before. Thus, assuming the distribution of each to be a function of time, uninfluenced by other factors, this would result in the occurrence of the primitive members at the periphery of the range of the group. That the conformity with Matthew's principle is coincidence only is evident from a similar examination of the Crepidinae, the most primitive members of which are found nearer the supposed center of origin than are many of the obviously derived members, or the observation that modern genetic theory, as clearly outlined in the treatise, lends no support whatsoever to any such principle of distribution. It is most unfortunate that the author, who must be fully aware of these conflicts, does not resolve them, for it is certain that less profound thinkers will seize upon this coincidental conformance as confirmation of the principle of Matthew by evidence from modern genetics.

The second volume is a model of systematic conception and execution. First, it includes the history and description of the genus, followed by diagnoses of and keys to the twenty-seven natural sections. These are then taken up, one by one, in order from primitive to intermediate to advanced. This order admittedly is progressive rather than phyletic, for phyletic relation-

ships may be other than linear. With some exceptions, each sectional treatment is introduced by a discussion of relationships and distribution of the species, usually illustrated with a map and accompanied by a key to the species. Then follow the treatments of individual species, again arranged in a progressive sequence. The descriptions are detailed and comparable point by point. Each species is illustrated with a figure, usually showing habit as well as other diagnostic features including the chromosome set when this is known for the species. The figures are drawn to the same scale and, again, are directly comparable. Following the specific description is a statement of geographical distribution and ecological relationships. Then comes the citation of critical specimens, followed by notes on the variability of the species, often including a numbered list of variants held to be minor. Concluding is a statement of specific relationships based on a synthesis of all available evidence. In those cases in which there is more than one subspecies, slight departure is made from the above sequence, but the treatment again is consistent.

Professor Babcock, whose achievements in genetics and evolution are widely recognized, is to be congratulated on this outstanding triumph in systematics. Likewise, the wise and farsighted policy of the administration of the California Experiment Station, in supporting this excursion into pure science for more than a quarter of a century, is to be highly commended. It is only from unqualified support such as this that truly great advances in science may be expected.—Marion Ownbey, State College of Washington.

NOTES AND NEWS

A Possible Record of Quercus Morehus in Oregon. An interesting oak thought to be *Quercus Morehus,* has been found along the Lower Grave Creek County Road about 6.2 miles west of Leland, northern Josephine County (Sect. 32 or 33 S., T. 33 S., R. 7 W., Willamette Meridian). To date, only leaf specimens have been collected, but if the tree proves to be *Q. Morehus,* it will be the first record of the occurrence of this species in Oregon.—Oliver V. Matthews, Salem, Oregon.

A small residue of back numbers of the biological journal, "Zoe", published by T. S. and Katharine Brandegee from 1890 until 1908, has come to light. From volume I, numbers 1, 2, 3, 6, and 8 are missing; from volume II, numbers 1 and 2 are missing; volumes III and IV are complete; volume 5 is complete except for number 1. Information concerning this material may be obtained from the secretary of the California Botanical Society.